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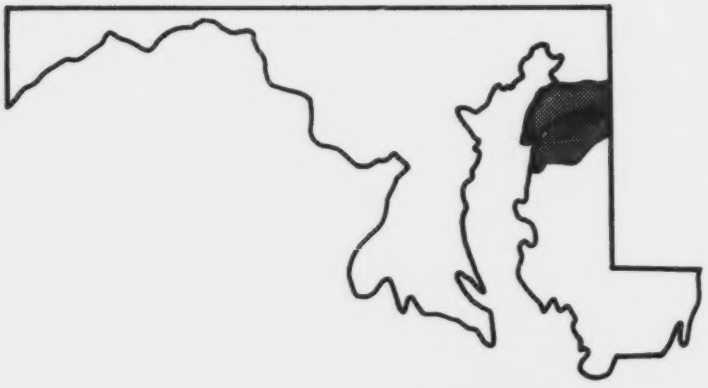
ORIGINAL

FLOOD INSURANCE STUDY

COMPLETED

TOWN OF MILLINGTON, MARYLAND
KENT AND QUEEN ANNES COUNTIES



MAY 3, 1982

Federal Emergency Management Agency

COMMUNITY NUMBER - 240058

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
TOWN OF MILLINGTON, MARYLAND

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Millington, Kent and Queen Annes Counties, Maryland, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Millington to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the Soil Conservation Service for the Federal Emergency Management Agency, under Inter-Agency Agreement No. H-11-79, Project Order No. 14. This work was completed in April 1981.

1.3 Coordination

In January 1979, streams requiring detailed and approximate study were identified at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of the FEMA, the Town of Millington, and the Soil Conservation Service (SCS - the study contractor). Other agencies contacted for coordination were the Baltimore District of the U. S. Army Corps of Engineers (COE), the U. S. Geological Survey (USGS), and the Maryland Water Resources Administration. During the course of the study, peak discharges, flood elevations and boundaries, and floodway delineations were reviewed by community and county officials and

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officials of the Maryland State Department of Natural Resources. On December 8, 1981, the results of the study were reviewed at a final CCO meeting held with representatives of the FEMA, the town, the SCS and the Maryland State Department of Natural Resources.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Millington, Kent and Queen Annes Counties, Maryland. The area of study is shown on the Vicinity Map (Figure 1).

The entire length of the Chester River within the corporate limits and Cypress Branch from its confluence with the Chester River to State Route 291 were studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through April 1986.

2.2 Community Description

The Town of Millington is located in the southeast portion of Kent County, the northeast portion of Queen Annes County, and the northeast portion of Maryland. The town is approximately 20 miles northwest of Dover, Delaware, and approximately 12 miles northeast of Chestertown, Maryland. Millington serves as a rural market and service center for the surrounding area. It had a population of 474 in 1970. State Routes 313 and 291 are the major highways in the area, and these are supplemented by Conrail.

Development in Millington is located along the two major highways and several side streets branching off of them. Some houses are located in the flood plain for easy boat access to the river.

The Chester River is formed by the junction of Cypress Branch and Andover Branch, just upstream of Millington. The southern boundary of the town is partly defined by an abandoned mill race.

2.3 Principal Flood Problems

There is no stream gaging station on the Chester River, meaning there is no systematic record of the magnitudes of past floods. The worst flood in recent years occurred during Tropical Storm Agnes in June 1972 and had an estimated recurrence interval of approximately 50 years. Approximately 70 buildings are affected by the 100-year flood. The State Route 313 and Conrail bridges are inadequate to convey higher flood flows and, therefore, some ponding occurs upstream of these bridges.

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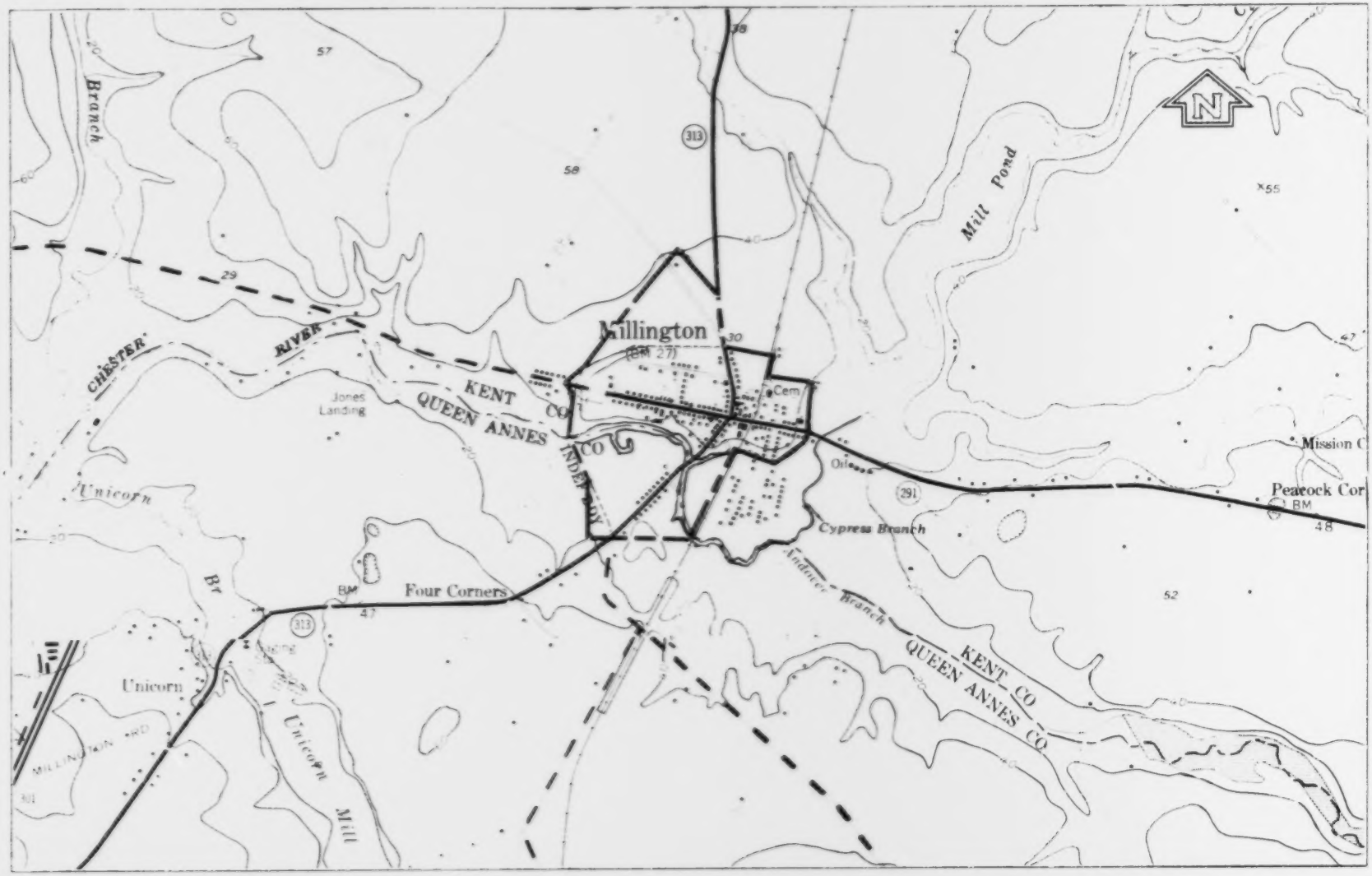

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF MILLINGTON, MD
(KENT AND QUEEN ANNES COS.)

APPROXIMATE SCALE

2000 0 2000 4000 6000 FEET

VICINITY MAP

Figures 2 and 3 show potential 100- and 500-year flood elevations at three locations within the Town of Millington. Figures 4 and 5 show past flooding near Millington.

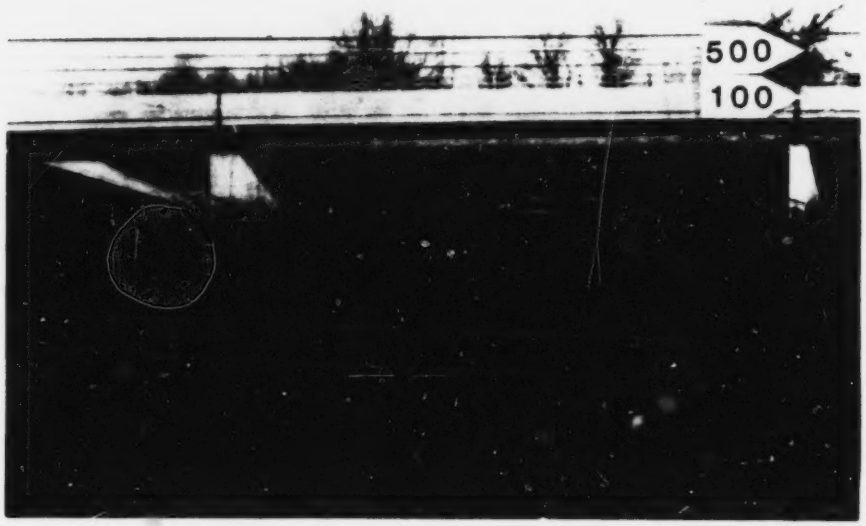

Figure 2 - Potential 100- and 500-year flood heights at the State Route 313 bridge over the Chester River in Millington, looking downstream.

2.4 Flood Protection Measures

At present, there are no flood protection structures existing which would reduce flooding in the Town of Millington. The building code of the town contains some restrictions on building in the flood plain. All new construction, substantial improvements, or major repairs to any building or structure in a flood area must be anchored to prevent movement or collapse, must use flood resistant materials or equipment, and must use construction methods and practices to minimize flood damage. The lowest floor of new construction or substantial improvements must be located at or above the 100-year flood level for residences, and at or above the 100-year flood level or be floodproofed for non-residential buildings and structures. In riverine areas, designated floodways must be able to pass the 100-year flow, no use will raise the 100-year flood level more than one foot, and encroachments in the floodway must be offset by channel improvements (Reference 1).

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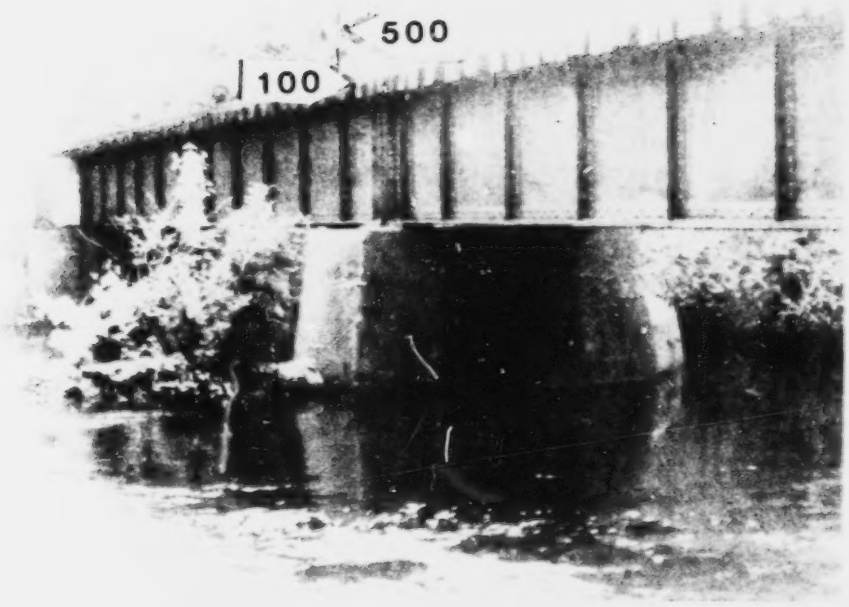

Figure 3 - Potential 100- and 500-year flood heights at the downstream side of the Conrail bridge over the Chester River in Millington.

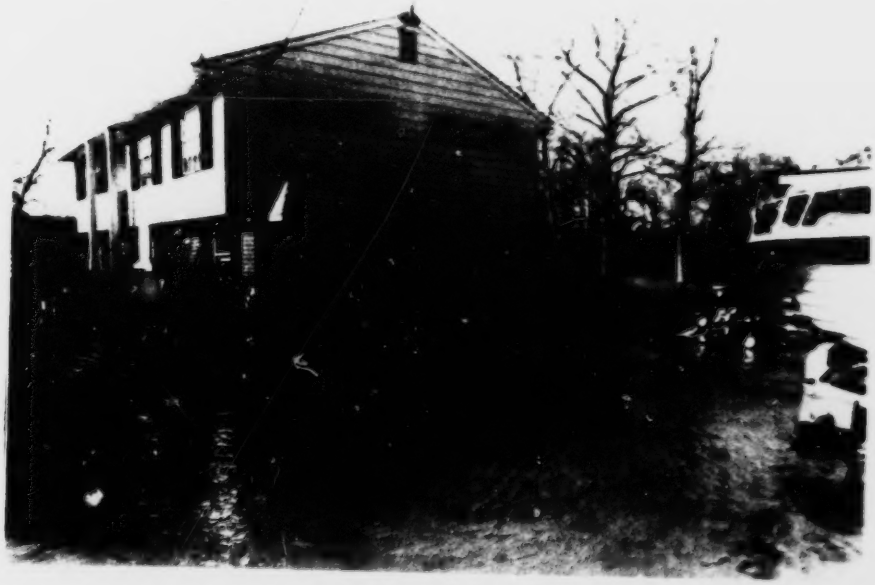

Figure 4 - Flooding from the Chester River in Queen Annes County outside of Millington - January 26, 1978.

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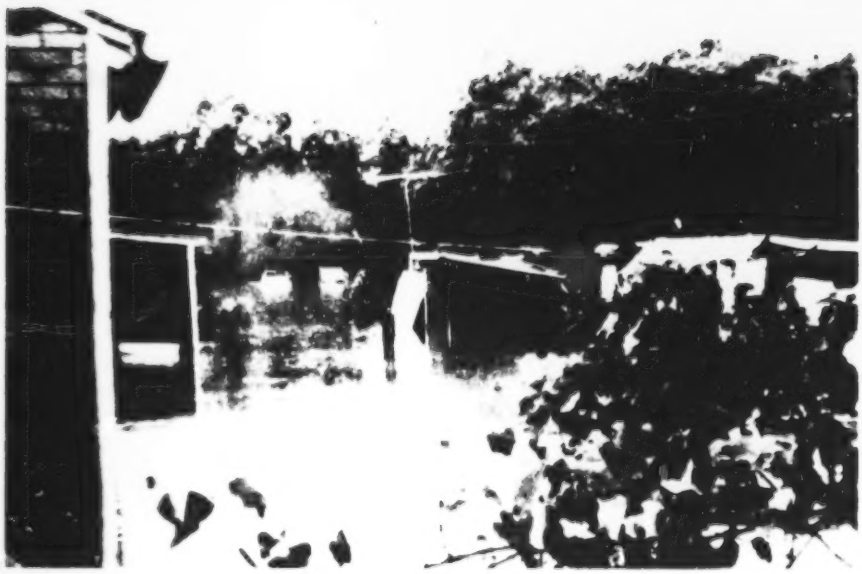

Figure 5 - Flooding caused by Tropical Storm Agnes, June 1972, on Cypress Branch in Sandfield, east of Millington.

The Kent County Subdivision Ordinance states, "that land subject to periodic flooding shall not be subdivided for residential occupancy nor for any other use which might involve danger to health, life, or property, or aggravate the flood hazard".

The State of Maryland has a code stating that wherever private activity changes in any manner, "the course, current, and cross section of any stream or body of water", within state waters, a permit is required. State waters are defined to include the flood plain of free flowing waters determined by the Department of Natural Resources on the basis of the 100-year flood. Regulations of the Department of Health and Mental Hygiene require that proper drainage and flood considerations be incorporated into land development activities. Activities of the Department of Planning relate primarily to overseeing land-use activities statewide and offering advice and assistance so that land-use changes which create a potentially serious flooding situation are avoided.

Section 8-1011 through 8-1018 of the Natural Resources Article enacts a State Sediment Control Program to provide for local soil and shore erosion control programs which are related to flood management.

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3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Data from the Upper Chester River Watershed Project were used in the hydrologic analysis (Reference 2). The Upper Chester River Watershed Project involves channel modification in the headwaters of Cypress Branch and Andover Branch. It was determined during the investigations made for this project that flooding conditions in Millington would not be significantly affected by the project. For the Chester River, a statistical analysis was made of stream gages on the eastern shore of the Chesapeake Bay by the USGS, and a regional peak flood-flow frequency-drainage area relationship was determined to use for estimating peak flood flows for any given drainage area (References 3 and 4). The SCS TR-20 computer program was used to determine the relationship and timing of flood peaks on Cypress Branch and Andover Branch, and the resultant flood-flow peaks on the Chester River in Millington (Reference 5).

Hydrographs were generated assuming Type II 24-hour rainfall. Total point precipitations for the 10-, 50-, and 100-year storms were 5.3 inches, 6.6 inches, and 7.5 inches, respectively. The precipitation for the 500-year storm was estimated by fitting an extreme value distribution to the rainfall data. The resulting value was 10.1 inches (Reference 6).

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A summary of drainage area-peak discharge relationships for the Chester River and Cypress Branch is shown in Table 1, "Summary of Discharges".

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CHESTER RIVER					
At the downstream corporate limits	87.2	3,244	6,307	8,126	13,633
CYPRESS BRANCH					
At the confluence with the Chester River	39.9	2,156	3,130	4,100	6,950

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

Data developed in the Upper Chester River Watershed Project were also used in the hydraulic analyses (Reference 2). Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the SCS WSP-2 water-surface profile computer program (Reference 7). Starting water-surface elevations for the Chester River were determined from tidal elevation-frequency data provided by the FEMA (Reference 8), and backwater curves run upstream to determine the extent of tidal flooding and the water-surface elevations for the study area for the selected flood flow frequencies. Starting water-surface elevations for Cypress Branch were determined using coincident peak conditions with the Chester River. For the frequencies studied, the flooding in Millington is riverine rather than tidal.

Cross-sectional data were obtained by field survey, as were the dimensions of bridges and culverts. In order to compute the significant backwater effects of bridges and culverts, cross sections were located immediately upstream and downstream of these structures.

Channel roughness factors (Manning's "n") used in the hydraulic computations were assigned on the basis of field inspection and previously established guidelines (Reference 9). The channel "n" values for the Chester River and Cypress Branch ranged from 0.045 to 0.075, and the overbank "n" values ranged from 0.050 to 0.120.

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Flood profiles were drafted using computed water-surface elevations with the effect of varying tidal elevations taken into account. The flood profiles were drawn to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FEMA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using maps at a scale of 1:100, to which the study contractor added 1-foot contour information (Reference 10). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

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4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FEMA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. No floodway was shown for Cypress Branch since only the 500-year flood boundary is within Millington.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 6.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FEMA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source affecting the Town of Millington.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Chester River								
A	145	298	3,909	2.1	13.0	13.0	14.0	1.0
B	995	554	5,222	1.6	13.4	13.4	14.4	1.0
C	1,920	222	2,480	3.3	13.7	13.7	14.7	1.0
D	2,430	466	5,195	1.6	14.0	14.0	15.0	1.0
E	2,585	421	4,960	1.6	14.1	14.1	15.1	1.0

[1] Feet above corporate limits

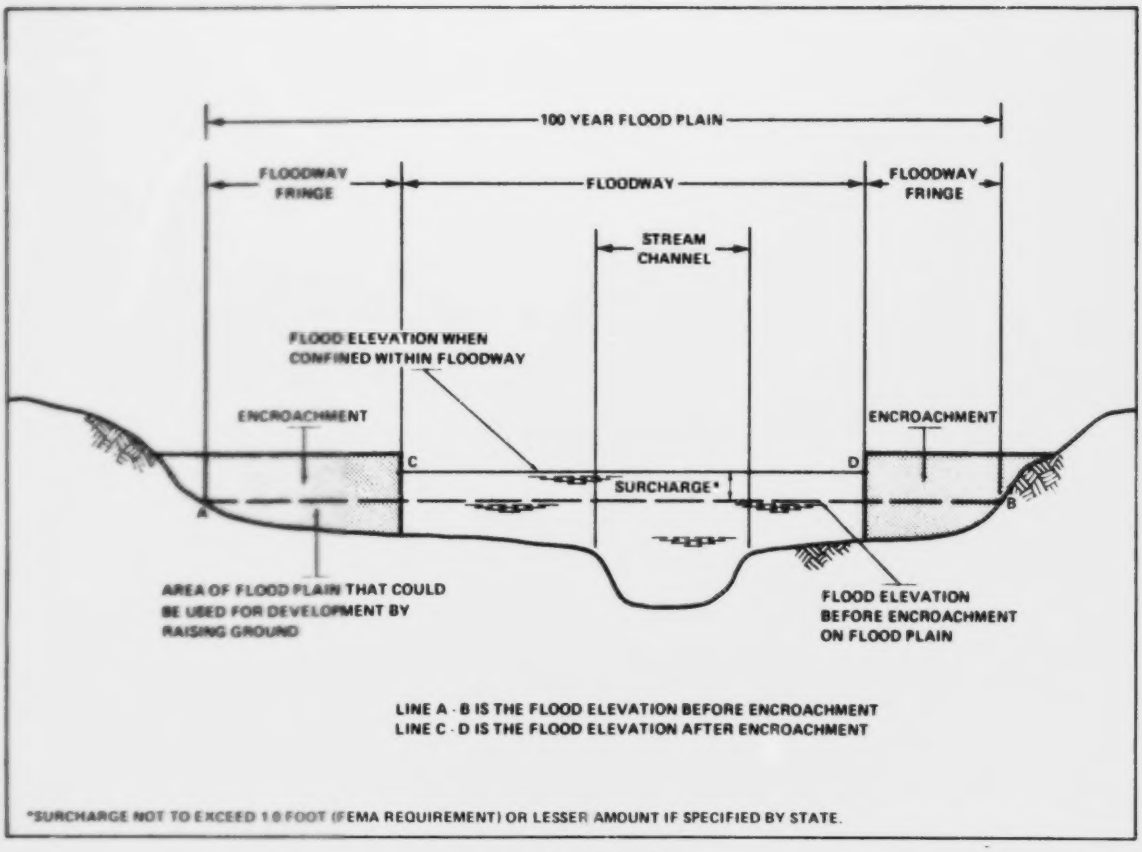
TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF MILLINGTON, MD
(KENT AND QUEEN ANNES COS.)

FLOODWAY DATA

CHESTER RIVER


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 6

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the Town of Millington are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Chester River Reach 1	01	-5.3	-1.5	+3.0	055	A11	Varies
Cypress Branch Reach 1	01	-4.4	-1.5	+2.7	045	A9	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF MILLINGTON, MD
(KENT AND QUEEN ANNES COS.)

FLOOD INSURANCE ZONE DATA

CHESTER RIVER AND CYPRESS BRANCH

5.2 Flood Hazard Factors

The FHF is the FEMA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Town of Millington was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zones A9 and A11: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.

Zone B: Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the Town of Millington.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Town of Millington is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood

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insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FEMA.

6.0 OTHER STUDIES

Data developed in the SCS Upper Chester River Watershed Project were used in the hydrologic and hydraulic analyses for this study (Reference 2). Flood Insurance Studies for the unincorporated areas of Kent County and Queen Annes County are currently being prepared (References 11 and 12). The results of those studies will be in exact agreement with the results of this study.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Room 700, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

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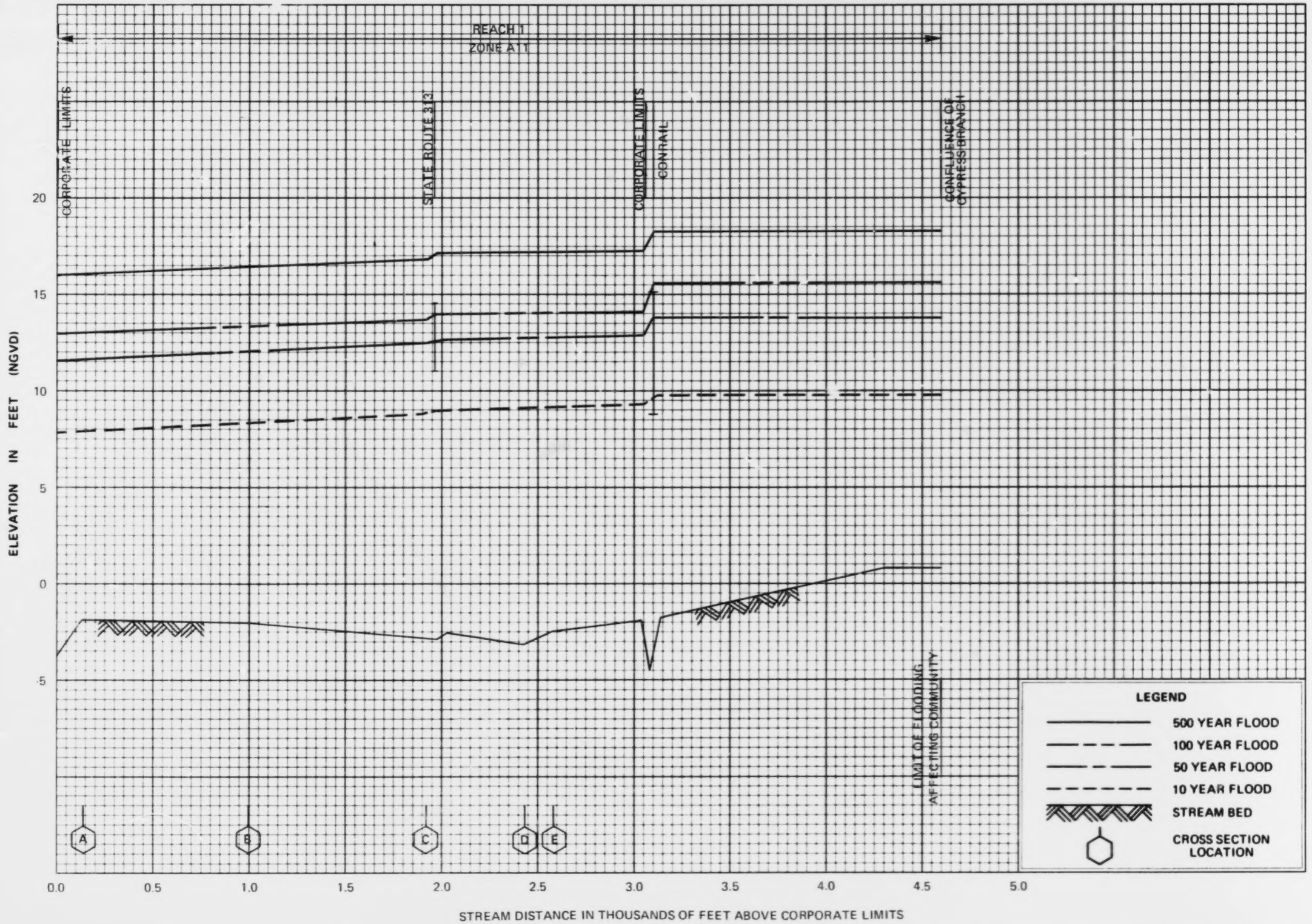

FLOOD PROFILES

CHESTER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF MILLINGTON, MD
(KENT AND QUEEN ANNES COS.)

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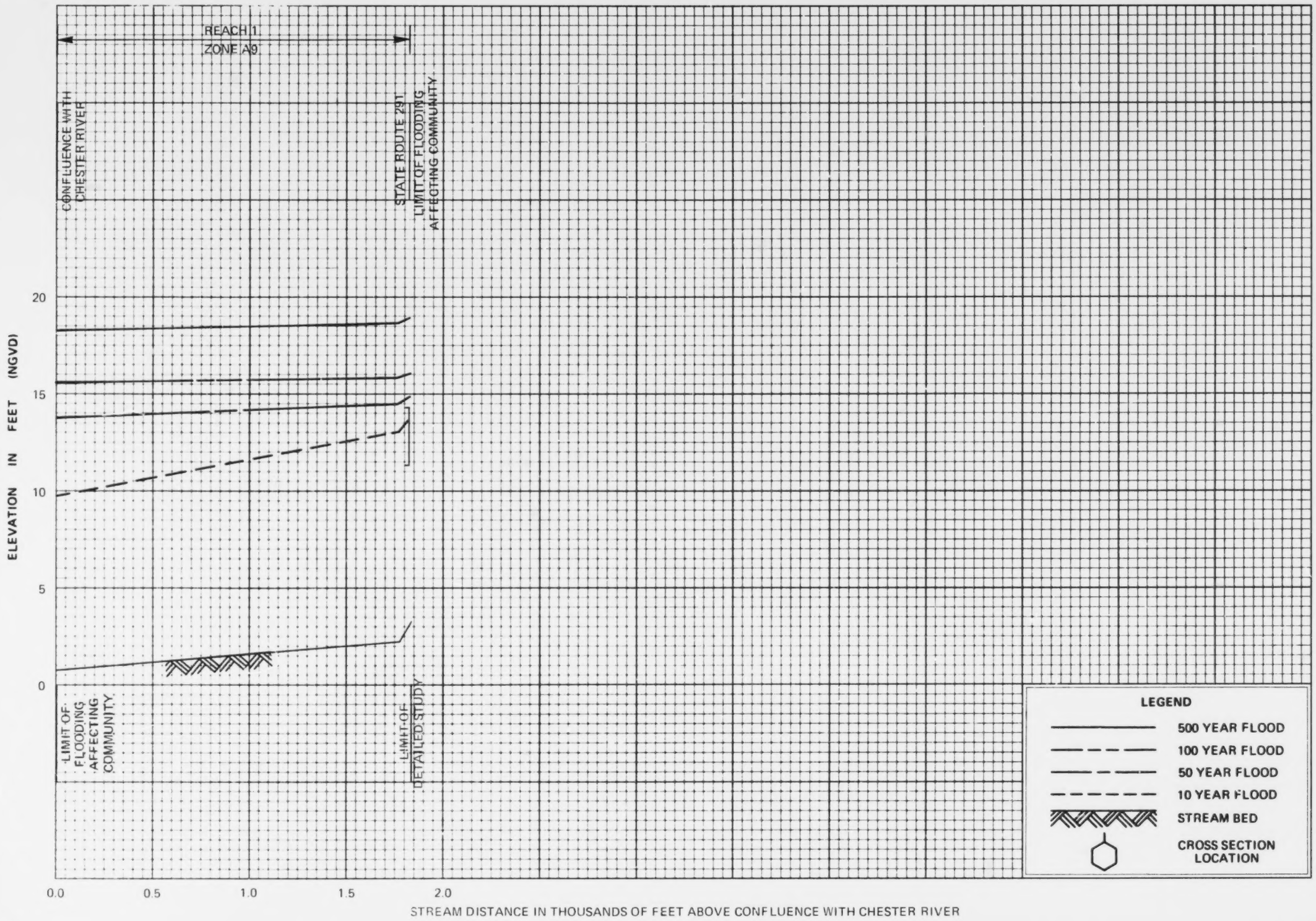

FLOOD PROFILES

CYPRESS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF MILLINGTON, MD
(KENT AND QUEEN ANNES COS.)

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